A HYDROGEOMORPHIC APPROACH TO EVALUATING FLOOD POTENTIAL IN CENTRAL TEXAS FROM ORBITAL AND SUBORBITAL REMOTE SENSING IMAGERY[1]

by

Victor R. Baker, Robert K. Holz and Steven D. Hulke

Central Texas is subject to flooding of extraordinary magnitude, particularly in the frequency range of 10-50 years. Assuming that stream network geometry has been adjusted to these floods, quantitative drainage network analysis can be used to relate stream morphology to potential flood discharge. Stream network geometrics were digitized from Skylab S-190B imagery, high-altitude and low-altitude aerial photographs, and large scale topographic maps. The digitized data were then used to generate significant hydrogeomorphic parameters with The W.A.T.E.R. System, a computer program for watershed analysis developed at the Universities of Toronto and Purdue. A tentative model for flood potential evaluation was established by relating known peak discharge measurements to corresponding drainage basin areas, basin shapes, drainage densities, total stream lengths, and frequencies of first order streams for given rainfall intensity factors. Locally, this model provides a more accurate basis for extrapolating hydrologic data than does conventional regional flood frequency analysis.

A critical factor in comparing the hydrogeomorphic utility of the various imagery formats is their ability to resolve the smallest unbranched stream segments in a drainage network. Resolution is illustrated by the following results from analysis of the upper Bee Creek basin (1.81 mi^2) near Austin, Texas:

Source:	Topographic Map	Low - Altitude Aerial Photography	Skylab S-190B
Scale:	1:24,000	1:22,200	1:172,000
Apparent No. of First Order Streams:	82	55	26
Bifurcation Ratio:	4.56	3.93	5.02
Mean Length of First Order Streams (miles):	0.133	0.133	0.15

1 Work supported in part by the National Aeronautics and Space Administration Contract No. NAS 9-13312.

A second critical factor is the ability of various imagery formats to most accurately depict current land-use factors in the drainage basin that may be of significance in affecting flood magnitudes. Urban hydrologic studies in the region have shown that land-use factors alone can increase peak flood discharge by as much as 300%, all other hydrologic facotrs held constant. Continuous orbital monitoring holds the promise for the most accurate depiction of hydrologically significant land-use factors, particularly in areas of rapid change like the Highland Lakes region of central Texas.

An important by-product of hydrogeomorphic analysis is the production of data useful in related regional hydrologic studies of runoff and base flow. This information includes: 1) wavelength of valley and channel meanders; 2) distribution, type and density of vegetation; 3) distribution of exposed bedrock and caliche; 4) estimation of relief as aided locally by the contour-like character of resistant limestone units; and 5) distribution of roads, fence lines, drainage ditches, and other human disruptions of the natural drainage geometry.